

## PATENT COOPERATION TREATY

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INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY  
(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference PE18834PC00	<b>FOR FURTHER ACTION</b> See Form PCT/IPEA/416	
International application No. PCT/SE2003/002083	International filing date (day/month/year) 23-12-2003	Priority date (day/month/year) -
International Patent Classification (IPC) or national classification and IPC See Supplemental Box		
Applicant Telefonaktiebolaget LM Ericsson (publ) et al		

- This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
- This REPORT consists of a total of 6 sheets, including this cover sheet.
- This report is also accompanied by ANNEXES, comprising:
  - ☒ (sent to the applicant and to the International Bureau) a total of 6 sheets, as follows:
    - ☒ sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
    - ☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
  - ☐ (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) \_\_\_\_\_, containing a sequence listing and/or tables related thereto, in electronic form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).

- This report contains indications relating to the following items:

- |                                     |              |   |
|-------------------------------------|--------------|---|
| <input checked="" type="checkbox"/> | Box No. I    | Basis of the report   |
| <input type="checkbox"/>            | Box No. II   | Priority  |
| <input type="checkbox"/>            | Box No. III  | Non-establishment of opinion with regard to novelty, inventive step and industrial applicability  |
| <input type="checkbox"/>            | Box No. IV   | Lack of unity of invention  |
| <input checked="" type="checkbox"/> | Box No. V    | Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement |
| <input type="checkbox"/>            | Box No. VI   | Certain documents cited   |
| <input type="checkbox"/>            | Box No. VII  | Certain defects in the international application  |
| <input type="checkbox"/>            | Box No. VIII | Certain observations on the international application   |

Date of submission of the demand  17-06-2005	Date of completion of this report  29-03-2006
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INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.

PCT/SE2003/002083

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of: Cover sheet

**International patent classification (IPC)**

**H04Q 7/38** (2006.01)

**H04B 7/02** (2006.01)

## INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.

PCT/SE2003/002083

**Box No. I Basis of the report**

1. With regard to the
- language**
- , this report is based on:

- ☒ the international application in the language in which it was filed
- ☐ a translation of the international application into \_\_\_\_\_ ,  
which is the language of a translation furnished for the purposes of:
- ☐ international search (Rules 12.3(a) and 23.1(b))
- ☐ publication of the international application (Rule 12.4(a))
- ☐ international preliminary examination (Rules 55.2(a) and/or 55.3(a))

2. With regard to the
- elements**
- of the international application, this report is based on (
- replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report*
- ):

- ☐ the international application as originally filed/furnished
- ☒ the description:
- pages 1 - 16 \_\_\_\_\_ as originally filed/furnished
- pages\* \_\_\_\_\_ received by this Authority on \_\_\_\_\_
- pages\* \_\_\_\_\_ received by this Authority on \_\_\_\_\_
- ☒ the claims:
- pages \_\_\_\_\_ as originally filed/furnished
- pages\* \_\_\_\_\_ as amended (together with any statement) under Article 19
- pages\* 1 - 6 \_\_\_\_\_ received by this Authority on 17-02-2006
- pages\* \_\_\_\_\_ received by this Authority on \_\_\_\_\_
- ☒ the drawings:
- pages 1 - 9 \_\_\_\_\_ as originally filed/furnished
- pages\* \_\_\_\_\_ received by this Authority on \_\_\_\_\_
- pages\* \_\_\_\_\_ received by this Authority on \_\_\_\_\_
- ☐ a sequence listing and/or any related table(s) – see Supplemental Box Relating to Sequence Listing.

- 3.
- ☐
- The amendments have resulted in the cancellation of:

- ☐ the description, pages \_\_\_\_\_
- ☐ the claims, Nos. \_\_\_\_\_
- ☐ the drawings, sheets/figs \_\_\_\_\_
- ☐ the sequence listing (*specify*): \_\_\_\_\_
- ☐ any table(s) related to the sequence listing (*specify*): \_\_\_\_\_

- 4.
- ☐
- This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

- ☐ the description, pages \_\_\_\_\_
- ☐ the claims, Nos. \_\_\_\_\_
- ☐ the drawings, sheets/figs \_\_\_\_\_
- ☐ the sequence listing (*specify*): \_\_\_\_\_
- ☐ any table(s) related to the sequence listing (*specify*): \_\_\_\_\_

\* If item 4 applies, some or all of those sheets may be marked "superseded."

## INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.

PCT/SE2003/002083

**Box No. V** Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

## 1. Statement

Novelty (N)	Claims	<u>1-39</u>	YES
	Claims	_____	NO
Inventive step (IS)	Claims	_____	YES
	Claims	<u>1-39</u>	NO
Industrial applicability (IA)	Claims	<u>1-39</u>	YES
	Claims	_____	NO

## 2. Citations and explanations (Rule 70.7)

**The claimed invention**

The invention concerns a method and device for combining soft information from several base stations and solves the problem with lack of capacity in the transport network, when combining soft information from several base stations in a central node.

The aim of the invention is to improve the capacity of the cellular network.

**Prior-art**

Reference is made to the following documents:

D1: "Multiuser detection with cell diversity for DS/CDMA systems", by Zhang Q. et al.

D2: "Multiuser detection with base station diversity" Valenti, M.C. et al

D3: US 5539749 A

D4: "Improved soft handoff and macro-diversity for mobile radio", by Papen W.

D5: "Distributed compression for sensor networks", by Kusuma J., et al

D6: "Distributed detection with multiple sensors: Part I-Fundamentals", Viswanathan R. et al.

Document D1 describes a multi-bit soft decision making and decision combining scheme. Different base stations providing cell diversity for a given mobile extract decision statistics from the received signal, quantize them and transmit the quantized statistics to a central processor. Based on the received quantized cell decision statistics, the central processor makes the final decision regarding the information bit stream that the mobile transmits. The quantized cell decision statistics can be considered as soft decisions (see D1 Chapter: I Introduction).

.../...

**Supplemental Box**

In case the space in any of the preceding boxes is not sufficient.

Continuation of: BOX V

Documents D2, D3 and D4 describe, as in document D1, a soft decision and combining scheme providing cell diversity. Documents D1, D2, D3 and D4 are considered to contain equivalent techniques.

Documents D5-D6 represents the general state of the art.

**Statement of reason**

Claims 1, 12, 23, 34 and 37

Document D1 is considered to represent the closest prior art. D1 describes a method for transmitting soft information received at several base stations to a combining unit, wherein the soft information is combined.

The invention according to claim 1 differs from the method in D1 in that the soft information is compressed before being transmitted to the combining unit and decompressed before being combined.

Due to these features, the amount of data being transmitted on the transport network between the base stations and the combining unit is reduced.

Consequently, with the background of D1, the problem is to develop a method which reduces the amount of data being transmitted between the base station and the combining unit.

As the applicant states in response to the written option, the "soft information" transmitted to the combining unit described in D1 is already compressed by quantization to reduce the bandwidth in the transport network.

However, for a person skilled in the art there exist several well-known methods to reduce the amount of data being transmitted between the base station and the combining unit, for example quantization (as in document D1), lossy compression, vector quantization, or Huffman coding, i.e. there exist several data compression methods which a person skilled in the art would choose from.

.../...

**Supplemental Box**

In case the space in any of the preceding boxes is not sufficient.

Continuation of: BOX V

Since the application is not about developing a new data compression method but rather using well known compression methods, and since no unexpected effects or properties are seen, the skilled person would regard it as a normal design option to choose one of the well-known compression and decompression methods in order to solve the problem posed.

Thus, the subject-matter of claim 1 does not involve an inventive step.

The same arguments apply, mutatis mutandis, to independent claims 12, 23, 34 and 37.

Claims 2-11, 13-22, 24-33, 35-36 and 38-39

The remaining claims are considered to involve particular detail executions obvious to a person skilled in the art.

## CLAIMS

1. A multiple path information transfer method in a cellular radio network, including the steps of

5 receiving, at several receivers connected to a transport network, radio signals representing digital information from at least one signal source;

extracting, from each received radio signal, a corresponding digitized baseband signal that at least partially contains soft information;

10 compressing at least parts of the soft information of said extracted baseband signals into a de-compressible form to form compressed baseband signals;

forwarding said compressed baseband signals to a combining unit over said transport network;

15 de-compressing said forwarded signals to at least approximately restore said baseband signals; and

using said de-compressed signals to at least approximately restore said digital information.

20 2. The method of claim 1, including the step of performing noise suppression on at least parts of said extracted baseband signals before compression.

3. The method of claim 2, wherein said noise suppression is performed by a posteriori probability filtering.

25 4. The method of claim 3, wherein said noise suppression is performed by maximum a posteriori filtering.

5. The method of claim 3, wherein said noise suppression is performed by log maximum a posteriori filtering.

30 6. The method of any of claims 2-5, wherein said noise suppression is performed during soft output demodulation.

7. The method of any of claims 2-5, wherein said noise suppression is performed on the output signal from a soft output demodulator.

8. The method of claim 1, wherein said compressing step includes vector quantization of at least parts of the soft information.

9. The method of claim 1, wherein the compression in said compressing step is lossy.

10. The method of claim 1, including the step of selecting compression mode for said soft information at least partially based on at least one feedback signal from said combining unit.

11. The method of claim 1, including the step of selecting compression mode for said soft information at least partially based on channel estimates.

12. A multiple path information transfer system in a cellular radio network, said system including

several receivers (BS-1, ..., BS-N), connected to a transport network, for receiving radio signals representing digital information from at least one signal source;

means for extracting, from each received radio signal, a corresponding digitized baseband signal that at least partially contains soft information;

means (10; 10A, 10B) for compressing at least parts of the soft information of said extracted baseband signals into a de-compressible form to form compressed baseband signals;

means (12, 14) for forwarding said compressed baseband signals to a combining unit over said transport network;

means (16; 16A, 16B) for de-compressing said forwarded signals to at least approximately restore said baseband signals; and

means (18-24) using said de-compressed signals to at least approximately restore said digital information.



13. The system of claim 12, including a noise suppressor (28, 30) performing noise suppression on at least parts of said extracted baseband signals before compression.

5 14. The system of claim 13, wherein said noise suppression is performed by a posteriori probability filters (28; 30).

15. The system of claim 14, wherein said noise suppression is performed by maximum a posteriori filters (28; 30).

10 16. The system of claim 14, wherein said noise suppression is performed by log maximum a posteriori filters (28; 30).

15 17. The system of any of claims 13-16, wherein said noise suppression is performed by soft output demodulators (28).

18. The system of any of claims 13-16, wherein said noise suppression is performed by filters (30) filtering output signals from soft output demodulators.

20 19. The system of claim 12, including means for vector quantization of at least parts of the soft information.

20. The system of claim 12, wherein said means for compressing is adapted to perform lossy compression.

25 21. The system of claim 12, including means for selecting compression mode for said soft information at least partially based on at least one feedback signal from said combining unit.

30 22. The system of claim 12, including means for selecting compression mode for said soft information at least partially based on channel estimates.

23. A base station in a digital radio network, said base station including  
a receiver for receiving a radio signal representing digital information  
from at least one signal source;

means for extracting a digitized baseband signal, which at least partially  
contains soft information, from said received radio signal; and

means (10; 10A, 10B) for compressing at least parts of the soft information of said extracted baseband signal into a de-compressible form to form a compressed baseband signal.

24. The base station of claim 23, including a noise suppressor (28, 30) performing noise suppression on at least parts of said extracted baseband signal before compression.

25. The base station of claim 24, wherein said noise suppression is performed by an a posteriori probability filter (28; 30).

26. The base station of claim 25, wherein said noise suppression is performed by a maximum a posteriori filter (28; 30).

27. The base station of claim 25, wherein said noise suppression is performed by a log maximum a posteriori filter (28; 30).

28. The base station of any of claims 24-27, wherein said noise suppression is performed by a soft output demodulator (28).

29. The base station of any of claims 24-27, wherein said noise suppression is performed by a filter (30) filtering output signals from a soft output demodulator (28).

30. The base station of claim 23, including means (10; 10A, 10B) for vector quantization of at least parts of the soft information.

31. The base station of claim 23, wherein said means for compressing is adapted to perform lossy compression.

32. The base station of claim 23, including means for selecting compression mode for said soft information at least partially based on at least one feedback signal from an external unit.

33. The base station of claim 23, including means for selecting compression mode for said soft information at least partially based on channel estimates.

34. A signal combining unit in a cellular radio network, said combining unit including

means (14) for receiving multiple signals from a transport network, each signal at least partially containing compressed soft information;

means (16; 16A, 16B) for de-compressing said soft information to form corresponding de-compressed baseband signals from said received signals, and

means (18-24) for combining said baseband signals based on said de-compressed soft information.

35. The signal combining unit of claim 34, including at least one lookup table for de-compressing vector quantized soft information.

36. The signal combining unit of claim 34, including means for sending at least one control signal to compression units to assist in selecting compression mode for said soft information.

37. A signal decoder node in a cellular radio network, said decoder including means (14) for receiving a signal from a transport network, said signal at least partially containing compressed soft information;

means (16; 16A, 16B) for de-compressing said soft information to form a corresponding de-compressed baseband signal from said received signal, and

means (24) for decoding said de-compressed baseband signal based on said de-compressed soft information.

38. The signal decoder of claim 36, including at least one lookup table for de-compressing vector quantized soft information.

39. The signal decoder of claim 37, including means for sending at least one control signal to a compression unit to assist in selecting compression mode for said soft information.

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